

# Technical News Bulletin

of the  
National Bureau of Standards

★ Issued Monthly ★

Washington

JUNE 1937

Number 242

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### THE IONOSPHERE AND RADIO TRANSMISSION

The ionosphere consists of several layers of ionized or electrically conducting air from 60 to 300 miles above the earth. These layers act as reflectors for radio waves and make possible radio transmission over long distances.

Depending on the degree of ionization of a layer, there is an upper limit to the frequency which, when the waves are sent straight up, may be reflected from the layer. Radio waves of frequencies greater than this upper limit, or critical frequency, go completely through the layer and pass entirely out into space. The critical frequency for each layer varies with the hour of the day, season of the year, and also over a long period which seems to be associated with the 11-year sunspot cycle.

The air in these layers is ionized principally by ultra-violet light from the sun. Consequently, the critical frequency would be expected to be greater during the day than during the night and greater during the summer than during the winter. This is true

for the lower layers, called E and F<sub>1</sub> layers. The uppermost or F<sub>2</sub> layer does not behave so regularly but attains its daily maximum critical frequency shortly after noon from October to March and about sunset from April to September. Strange as it may seem the maximum in the former period is considerably greater than in the latter. After sunset the critical frequency decreases but does not fall to zero.

The use of a multifrequency automatic recorder has made it possible to secure hourly ionosphere records at the Bureau since May 1933. The recent adoption of the idea of multifrequency automatic recording and the principle of this recorder by the Carnegie Institution of Washington, British Radio Research Board, Australian Radio Research Board, and Harvard University will increase enormously the continuity and value of ionosphere data, which will in turn greatly increase our understanding of world-wide ionosphere and radio transmission conditions.

The average critical frequencies and heights of the several layers, as measured near Washington, D. C., for each

hour of the day for each month from May 1934 to December 1936, inclusive, are plotted in RP1001 by T. R. Gilliland, S. S. Kirby, N. Smith, and S. E. Keymer, which will be published in the June number of the Journal of Research.

The upper limits for frequencies which can be used for transmission over long distances are several times greater than, but proportional to, the critical frequencies. Therefore, higher frequencies may be used for transmission during the winter day than at any other time, and higher frequencies may be used during the summer evening than at any other time of the summer day. Also, because of the increased sunspot activity, higher frequencies could be used in 1936 than in 1933.

In addition to the critical frequencies, the heights of the layers, and the amount of absorption of the radio waves play an important part in long-distance radio communication. The effects of these are discussed in the paper, and also two types of irregular disturbances of the ionosphere, which affect radio transmission.

#### WASHINGTON MEETING OF AMERICAN PHYSICAL SOCIETY

The two hundred and thirteenth regular meeting of the American Physical Society was held in Washington on April 29 and 30 and May 1. The sessions on the first 2 days were at the Bureau, while on May 1 the Society met in Corcoran Hall of George Washington University. The arrangements at the Bureau were in charge of E. C. Crittenden, assistant director for research and testing.

In all, approximately 160 papers were presented, of which two were by members of the Bureau's staff, as follows: Recombination in the afterglow of a discharge, by Fred L. Mohler; and Interference measurements in the spectra of the noble gases in the ultraviolet, by C. J. Humphreys.

The first paper described electrical measurements made of the number of ions per cubic centimeter, near the center of a 500 cm<sup>3</sup> bulb, and of the flow of current to the walls at various time intervals after the extinguishment of a discharge. The change in the number of ions in the bulb in a given time interval was found to be equal to the number flowing to the walls plus the number recombining in the space. Values were derived for the recombination coefficient under various conditions.

In the second paper, wave-length measurements in the ultraviolet region

of the first spectra of the noble gases were described. Interference measurements were made relative to the International Standard lines in Kr I and Ne I. It is expected that the more intense lines, measurements of which have been made available as the result of this work, will prove useful as wave-length standards. The neon group is most promising in this respect.

The usual dinner for members and their guests was held at the Raleigh Hotel on the evening of April 30. The speaker was David Sarnoff, president of the Radio Corporation of America, whose subject was Science and Society.

In connection with the meeting, many members availed themselves of the opportunity for discussing research problems with friends on the Bureau's staff and for inspecting the laboratories.

#### MEETING OF HOROLOGICAL INSTITUTE

The annual meeting of the Horological Institute of America was held at the National Academy of Sciences, Washington, on May 24. Arrangements for the meeting were made by Ralph E. Gould, corresponding secretary of the Institute and chief of the Bureau's time section.

The broad object of the Horological Institute is to raise the standard of watch repairing throughout the United States. Applicants for membership are required to pass an examination leading to either a Junior or a Certified Watchmaker's Certificate. The examination covers not only the theory of watch design and repairing, but also its practical side, the applicant being required to put a damaged watch in good running order, and to set jewels in a metal plate.

The 1937 meeting was opened by Harrison F. Babcock, president of the Institute. A short address of welcome was delivered by Henry W. Bearce, co-chief of the Bureau's Division of Weights and Measures. Charles T. Evans, secretary of the American National Retail Jewelers' Association, spoke on the relation of the Institute to the jeweler, and Howard L. Beehler, a member of the Institute's examining board, discussed the principal causes of failure among those taking watchmaker's examinations.

The annual dinner was held on the evening of May 24.

#### HERBERT L. WHITEMORE RECEIVES EDWARD LONGSTRETH MEDAL

Herbert L. Whittemore, chief of the Bureau's engineering mechanics section, was awarded the Edward Long-

streth Medal at the Franklin Institute in Philadelphia on May 19. The award was in recognition of Professor Whittemore's part in the development of the proving ring for determining the errors in the loads indicated by testing machines. These rings are being manufactured commercially in capacities up to 300,000 pounds and have largely supplanted other means of calibrating testing machines.

#### COMPENSATION OF STRAIN GAGES FOR VIBRATION AND IMPACT

The demand for adequate instruments for the measurement of strain in structures in vibration or under impact loads is well known. One of the difficulties encountered in trying to apply existing strain gages to the measurement of dynamic strain has arisen from deformations within the gage caused by the inertia of the gage itself when subjected to high accelerations. These deformations in general affect the reading of the gage and may cause serious errors. It has been customary in the past to decrease the mass and increase the rigidity of the gage in an effort to minimize these deformations, and correct for the small resulting error, if necessary, by means of control experiments. It is, however, frequently not feasible to construct a gage sufficiently light and rigid to make this possible.

A new method developed by W. M. Bleakney, and presented in the Journal for June (RP1005), consists in so adjusting the ratio of stiffness to inertia of the parts of the gage that these deformations are compensating. The indication of the instrument may thus be made independent of any acceleration of the gage as a whole.

This method is being used in the design of an electromagnetic strain pick-up unit developed for the Navy Department for the recording of strains in airplanes during flight. The Massachusetts Institute of Technology and the Sperry Gyroscope Co. are collaborating in this work. Further applications of the compensation principle will, no doubt, be found as improved instruments for measuring dynamic strains become available.

#### FEDERAL SPECIFICATIONS FOR FIRE-CLAY BRICK

Federal Specification HH-B-671b for fire-clay brick, representing a revision of Federal Specification HH-B-671a, was recently approved by the Director of Procurement of the United States Government to become effective not later than August 1, 1937. The re-

vised specification has eliminated the system of nomenclature, namely, M-73, H-57, H-75, and SH-75 for identifying the bricks for different classes of service. These classes will henceforth be known as: (1) Moderate heat; (2) slag-resistant; (3) intermediate heat; and (4) high heat, respectively. Furthermore, two new classes have been added, namely, (1) back-up duty, and (2) super-duty. The former class is for structural purposes such as exterior walls of boiler furnaces, and the latter for use under extremely severe service conditions where volume stability and resistance to temperature and slagging are important. The requirements for the back-up class are: (a) Pyrometric-cone equivalent, minimum 26 (1,595° C), and (b) compressive strength, minimum 3,000 lb/in<sup>2</sup>. The requirements for the super-duty class are: (a) Pyrometric-cone equivalent, minimum 33 (1,745° C); (b) linear contraction, maximum 1 percent; and (c) thermal spalling resistance, 18 cycles minimum after reheating at 1,450° C and quenching in water from 850° C. The slag-resistant class (formerly H-57) requires that the absorption be determined on the brick as delivered rather than on the brick after reheating at 1,400° C, as formerly. An upper limit of 10 percent is specified for absorption. No changes have been made in the requirements for the other classes.

Copies of this revised Federal specification are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents each.

#### COMPRESSIBILITY OF FUSED-QUARTZ GLASS AT ATMOSPHERIC PRESSURE

The determination, in terms of the standard meter, of the wave length in vacuo of standard radiations, such as the red line of cadmium, is a fundamental problem in length standardization. Since the direct comparison of cadmium light with the standard meter is necessarily carried out in the atmosphere, a knowledge of the index of refraction of air at standard temperature and pressure is essential for conversion of the values obtained by such direct comparison to values of wave length in vacuo.

One instrument used for determining this index of refraction is the Fabry-Perot Interferometer, consisting of two optical surfaces whose distance apart is fixed by a separator of material such as fused quartz. This instrument is used first at atmospheric pressure and then in vacuo to determine the change

in the number of wave lengths between the two surfaces.

Removal of the atmospheric pressure from any solid object results in a change in its dimensions of the order of one part in a million. The precision with which the length standards are defined is better than 1 part in 10 million; consequently, the change in length of the separator in index of refraction measurements, due to removal of atmospheric pressure, is an effect of significant importance. In order to apply corrections for this effect, the compressibility of materials used for separators must be accurately known.

Hitherto, compressibility measurements have been carried out only at pressures of many atmospheres because, with the methods used, changes in size of the order of many times those occurring for one atmosphere pressure change were required for making measurements. The use of results of these high pressure experiments to give compressibility at atmospheric pressure involves the uncertainty which is inherent in extrapolated values.

That uncertainty has been eliminated in an investigation recently completed by Walter B. Emerson of the Bureau's interferometry section, and reported in the *Journal of Research* for June (RP1003). Mr. Emerson used low pressures, made possible by adapting a method (first employed by the eminent English engineer and physicist, the late Arnulph Mallock) to a refined interferometric technique for measuring changes in size.

Specimens of fused quartz and a stainless steel were tested in the form of closed cylindrical tubes. Monochromatic light from a vacuum tube containing helium was directed onto the end of the tube arranged so as to produce interference fringes. The shift of these fringes measured the very small change in length accompanying a change in external pressure from vacuum to 1 atmosphere. The greatest change measured was less than 0.00001 inch.

In the case of fused quartz the accuracy of the results of this investigation is sufficient to insure that the controlling error in index of refraction measurements of air does not arise from the correction for compressibility of the separator.

#### CRYSTAL BEHAVIOR OF HYDROCARBONS

In connection with the American Petroleum Institute's Project 6 on the hydrocarbon constitution of petroleum,

it has been found of interest to study the possibilities of using the appearance and behavior of their crystals as a means of identifying hydrocarbons. A microscope for use at very low temperatures was designed by R. T. Leslie and W. W. Heuer with special consideration for compactness and ease of operation. The objective of the microscope, surrounded by a metal cryostat, was inclosed in a glass vacuum jacket in such a way that moisture from the atmosphere was excluded. A side tube which was also vacuum-jacketed, permitted free access to the stage for seeding and otherwise manipulating the crystals.

Various techniques were devised for causing the growth of large, well-formed crystals. Materials which crystallized readily were cooled until a mass of crystals formed; most of these were then melted and the remaining crystals served as "seeds" on recooling. Materials which were difficult to freeze were crystallized from solvents in a test tube, and some of the crystals were transferred to the stage of the microscope for observation or as "seed" crystals.

The homologous series of normal hydrocarbons from pentane to dodecane, benzene, ethylbenzene, the mono-, di-, and tri-methylbenzenes, six of the corresponding hydrogenated aromatics, and five branched-chain hydrocarbons with major chains varying from four to seven carbon atoms in length, were studied. It was found that the compounds differed greatly in the ease with which crystals formed and grew. Little difference could be observed in the appearance of the crystals in the homologous series. Materials which probably exist as condensed molecules differ in appearance from the open-chain molecules, however. The condensed molecules tended to form more or less equidimensional polyhedrons, while the open-chain compounds formed elongated prisms. This study is described more completely in the June number of the *Journal of Research* (RP1000), in which the conclusion is reached that the behavior of the crystals could be used, with other properties, as an aid in the identification of hydrocarbons.

#### ABBRIDGED VOLUME CORRECTION TABLE FOR PETROLEUM OILS

In order to meet the demand of the oil industry a Supplement to NBS Circular C410 has been prepared.

This abridged table differs from that published in Revised Supplement to

NBS Circular C154 issued in 1934 in three respects: The multipliers for Group 0 have been revised slightly; Group 1 has been extended from 249° to 499° F; and Groups 4, 5, and 6 have been extended from 99° to 124° F.

The multipliers in the Group 0 table in the Revised Supplement to NBS Circular C154 issued in 1934 were taken from the National Bureau of Standards Miscellaneous Publication M97. With the revision of Circular C154 (published as Circular C410) to include data on oils from 0° to 10° API, it has seemed desirable to employ the procedure followed in the other groups and choose the column of multipliers from the unabridged table which has a base coefficient of expansion nearest 0.00035, which in the case of Group 0 is the column corresponding to a gravity of 6° API.

Copies of the new Supplement are available from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents apiece.

#### SOIL-CORROSION TESTING

In considering the subject of soil corrosion two major factors require special attention: (1) The influence of the nature of the metal, and (2) the influence of the soil. The chief metals which are exposed to the soil in practice are iron and steel, and lead, copper, and brass. Zinc also is used extensively in the form of a coating. Since by far the greatest amount of metal exposed to the soil is iron and steel, research in the field of soil corrosion has been concerned chiefly with these metals.

The sources of information on soil corrosion are: (1) Examinations of pipe lines in service; (2) field tests of selected metals buried in selected soils; and (3) laboratory tests of metals in soils. Analysis of corrosion data from these sources has led to a procedure by which the corrosiveness of soils toward iron and steel can be determined.

A rational procedure for testing the corrosion of metals in soils must take into account: (1) The corrosiveness of the soil; (2) the relation between pit depth and area; and (3) the relation between pit depth and time. The corrosiveness of a soil toward ferrous metals may be determined in the laboratory by measuring the voltage at various current densities of a cell in which the electrodes are steel and the electrolyte is the soil under test. The average current density corresponding to a range of voltage between 0 and 0.3 v is expressed in terms of the average depth of the deepest pit to be expected

on 1 ft<sup>2</sup> at the end of 12 years. By means of an equation in which the depth of the deepest pit on a given area is expressed as a function of (1) the corrosiveness of the soil; (2) the area exposed; and (3) the period of exposure, the estimated depth of pit may be calculated for the desired area and time. A general equation has been developed for estimating the number of holes, if any, in pipe as a function of the corrosiveness of the soil, time, and wall thickness.

Empirical equations in which the depth of pit is expressed as power functions of time and exposed area have, likewise, been worked out, and the constants of the equations have been related to the properties of the soil. The slope of the pit depth-time curve when plotted on logarithmic coordinates has been found to be determined largely by the aeration of the soil; the more poorly aerated soils produce a slope.

The precision and range of application of the suggested procedure for soil corrosion tests is limited by imperfect understanding of certain features of soil corrosion, such as the exact nature of the relation connecting pit depth with exposed area. Although the Bureau's present method is not sufficiently well established to be adopted generally, it does constitute a basis on which a standard method may be developed.

#### ACCELERATED WEATHERING TESTS OF MINERAL-SURFACED ASPHALT SHINGLES

Recent tests by H. R. Snoke and B. E. Gallup of the Bureau's Chemistry Division, on mineral-surfaced asphalt shingles, show that all of the types of failure encountered in long outdoor exposures to the most severe weather conditions can be produced by accelerated weathering in 7 months or less.

As reported in RP1002 in the Journal of Research for June, 39 samples of standard-weight shingles, from 8 of the larger manufacturers, and including the natural and artificial granular surfacing materials most commonly used, were included in the test. Except that the shingles submitted by one manufacturer contained no fine mineral filler in the asphalt coatings, and that those from another were low in percentage saturation of the felt, analyses of the samples showed no differences in composition differences in their behavior to weathering.

Out doors exposures of these shingles normally require from 10 to 20 years to produce definite results, and consequently are of little value in predict-



ing the behavior to weathering of materials currently available, since raw materials and manufacturing processes are constantly changing. The accelerated weathering test should therefore be of considerable value, not only to purchasers of large quantities of these materials, but to manufacturers, as a means of improving their products.

#### BEHAVIOR OF LEATHER IN THE OXYGEN BOMB

The complete analysis of a sample of leather includes 10 or more separate determinations, and the time required for the completion of such an analysis is 2 to 3 days. In making investigations of the effect of acids or various leather-making materials on leather, it is also necessary to wait a considerable length of time before any significant results are obtained.

In order to simplify the present testing methods and to make investigations on a more rapid scale, Joseph R. Kanagy, of the Bureau's leather section, has started a study of the behavior of leather in the oxygen bomb as preliminary work in the development of an accelerated aging test. As described in the *Journal of Research* for June (RP1004), chestnut and quebracho-tanned leathers treated so as to have pH values ranging from 2 to 5, were exposed in the oxygen bomb under various conditions. Quebracho leather showed the greater stability under all conditions. An explanation for this difference in stability is suggested by a consideration of the generally accepted structures of these two tannins. Comparative data on the stability of various leathers under these conditions indicate that chrome leather is most stable, followed in order of decreasing stability by quebracho, a commercial blend, and chestnut. All results parallel those obtained previously under natural aging conditions.

#### PRESERVATION OF RECORDS

The results of further studies made as a part of the Bureau's effort to obtain comprehensive information on the preservation of records, are summarized in Miscellaneous Publication M154, a revised edition of the general report of this research.

Because of the rapidly growing use of motion-picture films as a means of reproducing record material, either as a preservative measure or for more general accessibility, the research was extended to a study of the stability and optimum storage conditions of films. Both the acetate and the nitrate films

were studied. The former was found to be a stable material, but information on the resistance of the emulsion to wear and other influences is incomplete. The nitrate film showed a comparatively short life, but information was developed on the most suitable conditions for maximum longevity in storage and use of both this and the acetate type. The study was made possible by the financial support of the Carnegie Foundation and the National Archives. The latter also supported an investigation to determine whether certain fumigants could be used to rid documentary material of insect life without injuring the material, because all incoming material is treated in fumigating chambers before it goes to the storage stacks. All of the fumigants studied were found to be harmless to paper.

Some revision has also been made in the summaries of the previous studies. These studies were initiated by a survey of the relation of conditions of storage in libraries to the condition of stored documentary material. The results indicate that light, temperature, and the humidity and purity of the air, are conditions which need careful control to minimize deterioration of stored material. Air acidified by sulphur dioxide from the combustion of fuels was found to be deteriorative to material stored in libraries of congested areas, but it was proved by investigation in the Folger Shakespeare Library that library air can be completely cleansed of this deteriorative gas. As a result of these studies, it is recommended that good library practice should include the use of diffused illumination, and as little of it as feasible, and the use of an air-conditioning system for the maintenance of moderate temperature and humidity and the removal of acidic gases from the air.

Tests of hundreds of old and modern papers showed the necessity for careful choice of paper for permanent record use, and that the selection should be based on the purity of the fiber, rather than its source, and on the purity of the paper in other respects. Protective coatings for papers were also given attention, and both transparent cellulose sheeting and Japanese tissue papers were found suitable.

Writing ink was known to be more or less deteriorative to paper. More exact information on this was obtained, which showed that the ordinary type of ink is distinctly injurious to all types of record papers. But the results of study of a special type of ink proposed

by other investigators indicated that it might be used without harmful effect.

The world-wide interest in these studies indicates that posterity will not be deprived of its rightful heritage of the accumulated recorded knowledge of preceding generations. There are many evidences that improved library practices are being inaugurated as the result of this work.

Copies of the new publication are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

#### **CIRCULAR OF PROPERTIES OF ENGINEERING MATERIALS**

Architects, engineers, designers of special machinery, and all those who are interested in the strength and other properties of engineering materials, and especially in unusual uses for metals and alloys, will be glad to know that an important publication of the Bureau in this field, which has been out of print for several years, is again available.

In reprinting Circular C101, *Physical Properties of Materials: Strengths and Related Properties of Metals and Certain Other Engineering Materials*, it was decided to reissue the publication without changes, but at the same time to provide a supplement carrying important corrections which have come to the Bureau's attention in the 13 years that have elapsed since the last printing of the Circular.

Anyone who orders a copy of C101 will also receive a copy of the supplement, while those who already have the Circular can purchase the supplement separately.

The price of the new printing of C101, complete with supplement, is 40 cents, while the supplement alone costs 5 cents. Orders should be sent to the Superintendent of Documents, Government Printing Office, Washington, D. C.

#### **COLOR CODE FOR MARKING STEEL BARS**

Simplified Practice Recommendation R166-37, *Color Code for Marking Steel Bars*, which became effective on April 1, 1937, was proposed and developed by the National Committee on Iron and Steel of the National Association of Purchasing Agents. The project was initiated in 1929 to meet the needs of members of the Association for a code that would make it possible to distinguish the various grades of steel and to expedite the taking of inventory, as well as to reduce shop errors.

The recommendation is limited to a color code for marking commonly used grades of steel, as represented by SAE numbers. The following kinds of steel are covered: Carbon, free-cutting, manganese, nickel, nickel-chromium, molybdenum, chromium, chromium-vanadium, tungsten, and silicon-manganese.

This proposal originally was submitted to the industry in August 1935, but so many constructive comments and suggestions were received during circularization that it was deemed desirable to revise the code to insure more general acceptance. In order to review the suggestions that had been received, a conference of representatives of interested groups was held in Cleveland, Ohio, on November 22, 1935. This meeting appointed a special committee to prepare a revised draft for resubmission to all interests. The committee, upon completion of its work, met in Cleveland on January 30, 1936, and after checking carefully each color and combination of colors, agreed that still further simplification of the list was practicable. A final draft was then prepared and approved by the committee, following which the Division of Simplified Practice was requested to submit the revised schedule to all concerned for acceptance as a substitute for the original proposal. This revision was sent out in September 1936.

The printed edition of the recommendation will include a brief history of the development of the project and a list of organizations and firms that have accepted the program.

Until the printed book is available, free mimeographed copies may be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington, D. C.

#### **REQUIREMENTS OF UNDERWRITERS' LABORATORIES RECOGNIZED IN FEDERAL SPECIFICATIONS**

The Federal Government does not carry fire insurance, and in consequence more than ordinary precautions are taken by the Government to reduce fire hazards. This is exemplified in a new preliminary requirement regarding Government purchases of electrical equipment and other supplies which may involve a fire risk. Bids for such supplies will be considered only when the bidders submit evidence that their products conform to the specifications of the Underwriters' Laboratories, Inc., as regards fire and casualty hazards. The new requirement, which has been approved by the Comptroller General's Office, reads as follows:

"The bidder shall submit proof that the material or appliance he proposes to supply under this specification conforms to the standards of the Underwriters' Laboratories, Inc., as regards fire and casualty hazards. The label of the Underwriters' Laboratories will be accepted as conforming with this requirement.

"In lieu of the label, the bidder may submit independent proof satisfactory to the purchasing agency that his material or appliance conforms to the published standards, including methods of test, of the Underwriters' Laboratories.

"Compliance with the above preliminary requirements as regards fire and casualty hazards does not absolve the bidder from complete compliance with the other requirements of this specification in order to secure the acceptance of his material or appliance."

In conformity with this decision, instructions have been issued under date of April 21, 1937 by Dr. Lyman J. Briggs, chairman of the Federal Specifications Executive Committee, to the technical subcommittees in charge of the preparation of specifications, that the above provision be included in future specifications, and that existing specifications be amended to include this provision in appropriate instances. Bidders on Government contracts in which fire and casualty hazards are involved should make special note of this new provision of the Government's purchasing requirements.

#### NEW AND REVISED PUBLICATIONS ISSUED DURING MAY 1937

##### Journal of Research<sup>1</sup>

Journal of Research of the National Bureau of Standards, title page, corrections, and contents to volume 17, July to December 1936 (RP899 to RP956, inclusive). Free on application to the Bureau.

Journal of Research of the National Bureau of Standards, volume 18, number 5, May 1937 (RP900 to RP999, inclusive). Price 25 cents. Obtainable by subscription.

<sup>1</sup> Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research \$2.50 per year (United States and its possessions, and Canada, Cuba, Mexico, Newfoundland, and the Republic of Panama); other countries, 70 cents and \$3.25, respectively.

#### Research Papers<sup>1</sup>

(Reprint from the April 1937 Journal of Research)

RP983. Calorimetric determination of the thermodynamic properties of saturated water in both the liquid and gaseous states from 100 to 374° C. N. S. Osborne, H. F. Stimson, and D. C. Ginnings. Price 10 cents.

#### Circulars<sup>1</sup>

Supplement to NBS Circular C101 (2d ed.), Physical properties of materials: I. Strengths and related properties of metals and wood. Price 5 cents.

Supplement to NBS Circular C410, Abridged volume correction table for petroleum oils. Price 5 cents.

#### Simplified Practice Recommendations<sup>1</sup>

R31-37. Loaded paper shot shells. (Supersedes R31-31.) Price 5 cents.

R62-37. Metallic cartridges. (Supersedes R62.) Price 5 cents.

R89-36. Coated abrasive products. (Supersedes R89-32.) Price 5 cents.

R156-37. Containers for extracted honey. (Supersedes R156-34.) Price 5 cents.

#### Miscellaneous Publications<sup>1</sup>

M154. Summary report of National Bureau of Standards research on preservation of records. A. E. Kimberly and B. W. Scribner. (Supersedes M144.) Price 10 cents.

#### Technical News Bulletin<sup>1</sup>

Technical News Bulletin 241, May 1937. Price 5 cents. Obtainable by subscription.

#### MIMEOGRAPHED MATERIAL

##### Letter Circulars

Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or to send copies automatically as issued.

LC493. Solders and soldering. (Supersedes LC343.)

LC494. Cement: Technical publications by members of the staff of the National Bureau of Standards. (Supersedes LC155 and LC156.)



LC495. Concrete and reinforced concrete: Technical publications by members of the staff of the National Bureau of Standards. (Supersedes LC155 and LC156.)

LC496. Structural clay products, stone, and masonry: Technical publications by members of the staff of the National Bureau of Standards. (Supersedes LC131-E, LC155, and LC156.)

LC497. Services of the National Bureau of Standards to Governmental purchasing agencies.

LC498. Methods of using standard frequency radio emissions.

LC499. The weekly broadcasts of the National Bureau of Standards on the ionosphere and radio transmission conditions.

# Technical Information on Building Materials

The supply of these notes, each of which consists of three or four pages giving the important facts on some one aspect of the properties or use of building materials, is necessarily limited. Their distribution will be confined to Government officials concerned with building projects, and to architects, engineers, and home builders. Requests should make clear the actual need for the information at the time of writing. Letters should be addressed to the Division of Codes and Specifications, National Bureau of Standards, Washington, D. C. The following notes have been issued since the list published in the May 1937 number of the Technical News Bulletin:

- TIBM-47. Varnish and lacquer.
- TIBM-48. Shellac.

## RECENT BUREAU ARTICLES APPEARING IN OUTSIDE PUBLICATIONS<sup>2</sup>

Shaking-table investigations of teleseismic seismometers. H. E. McComb and Frank Wenner. *Bul. Seismological Soc. Am.* (University of California Press, Berkeley, Calif.) 26, 291 (October 1936).

Development of a radio meteorograph system for the Navy Department. H. Diamond, W. S. Hinman, Jr., and F. W. Dunmore. *Bul. Am. Meteorological Soc.* (Blue Hill Observatory, Milton, Mass.) 18, 73 March 1937).

Sudden ionospheric disturbances. J. H. Dellinger. *Ter. Mag. and Atmos. Elec.* (Carnegie Institution, Washington, D. C.) 41, 49 (March 1937).

A radiometeorograph system with special aeronautical applications. H. Diamond, W. S. Hinman, Jr., and F. W. Dunmore. *J. Institute Aeronautical Sciences* (5431 RCA Building, New York, N. Y.) 4, 241 (April 1937).

Skip distance calculations. N. Smith. *QST* (38 La Salle Road, West Hartford, Conn.) 21, 47 (May 1937).

Some properties and tests of traffic or zone paints. E. F. Hickson. *National Paint, Varnish and Lacquer Association, Inc.*, (Washington, D. C.) Circular 532 (April 1937).

Lignin and lignin plastics. A review. Gordon M. Kline. *Modern Plastics* (425 Fourth Avenue, New York, N. Y.) 14, 39 (April 1937).

<sup>2</sup> These publications are not obtainable from the Government. Requests should be sent direct to the publishers.



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